

## Organochlorine Pesticides

### General Information

Organochlorine pesticides are effective against a variety of insects. Hexachlorobenzene and pentachlorophenol had been used primarily as fungicides. These chemicals were introduced in the 1940s and are used rarely in the United States today because of their environmental persistence. The U.S. EPA banned many of the uses of these chemicals during the 1970s and 1980s. Although many of these chemicals are no longer produced in the United States, they continue to be used by other countries.

Organochlorine pesticides enter the environment from disposal of contaminated wastes into landfills, emissions from waste incinerators, and releases from manufacturing plants that produce these chemicals. In aquatic systems, organochlorine pesticides are adsorbed onto sediments in water that can then bioconcentrate in marine mammals. Because these chemicals are soluble in fat, they are found at higher concentrations in fatty foods.

Diets that contain fats that may be contaminated with organochlorine pesticides (e.g., contaminated milk and dairy products, fish, whales) lead to increased exposure to these chemicals. Children can be exposed to these chemicals through breast milk and *in utero* through the placenta. The health effects of exposure to organochlorine chemical exposure on the general population at current levels of exposure are unknown. Workers can be exposed to organochlorine chemicals in the manufacture, formulation, or application of these chemicals. The FDA, U.S. EPA, and OSHA have developed criteria on the allowable levels of these chemicals in foods, the environment, and the workplace.

The organochlorine pesticides are a unique class of pesticides because of their cyclic structure, number of chlorine atoms, and low volatility. They can be classified into four categories: dichlorodiphenylethanes (e.g., DDT), cyclodienes, chlorinated benzenes (e.g., hexachlorobenzene [HCB]), and cyclohexanes (e.g., hexachlorocyclohexane [HCH]). Table 153 shows the parent organochlorine pesticides and their metabolites measured in this *Report*. For example, DDT metabolizes to DDE.

**Table 153. Organochlorine pesticides and their metabolites**

Organochlorine pesticide (CAS number)	Serum pesticide or metabolite(s) (CAS number)	Urinary pesticide or metabolite(s) (CAS number)
Hexachlorobenzene (118-74-1)	Hexachlorobenzene (118-74-1)	Pentachlorophenol (87-86-5) 2,4,6-Trichlorophenol (88-06-2) 2,4,5-Trichlorophenol (95-95-4)
Hexachlorocyclohexanes including beta-HCH (319-85-7) and gamma-HCH (58-89-9) isomers	Hexachlorocyclohexane (608-73-1)	Pentachlorophenol (87-86-5) 2,4,6-Trichlorophenol (88-06-2) 2,4,5-Trichlorophenol (95-95-4)
DDT (50-29-3) <i>p,p'</i> -DDT (50-29-3) <i>o,p'</i> -DDT (789-02-6)	<i>p,p'</i> -DDE (72-55-9)	
Heptachlor (76-44-8)	Heptachlor epoxide (1024-57-3)	
Mirex (2385-85-5)	Mirex (2385-85-5)	
Chlordane (12789-03-6)	Oxychlordane (27304-13-8)	
Pentachlorophenol (87-86-5)		Pentachlorophenol (87-86-5) 2,4,6-Trichlorophenol (88-06-2) 2,4,5-Trichlorophenol (95-95-4)

Measurements of these chemicals can reflect either recent or accumulated chronic exposures or both. Some of the metabolites can be produced from the metabolism of more than one pesticide. In addition to reflecting exposure to the parent pesticide, the level of the metabolite in a person's blood or urine may also reflect exposure to the metabolite itself if it was present in the person's environment.

*Interpreting Lipid-Adjusted Serum Organochlorine Levels Reported in the Tables*

Lipid-adjusted serum levels of organochlorine pesticides or their metabolites were measured in a subsample of NHANES 1999-2000 participants aged 12 years and older. Subsamples were randomly selected within the specified age range to be a representative sample of the U.S. population. Urine levels of metabolites were measured in people aged 6 years and older. Measuring these chemicals at these levels is possible because of advances in analytical chemistry. Finding a measurable amount of one or more organochlorines in the serum or urine does not mean that the levels of the organochlorines cause an adverse health effect. Whether organochlorines at the levels reported here are cause for health concern is not known; more research is needed.

These data provide physicians with a reference range so that they can determine whether people have been exposed to higher levels of organochlorines than those found in the general population. These data will help scientists plan and conduct research about exposure to organochlorines and their health effects.

## Hexachlorobenzene

CAS No. 118-74-1

### General Information

Hexachlorobenzene (HCB) is an organochlorine pesticide that was once used in the United States as a fungicide to pretreat grain. The U.S. EPA canceled registered use in 1984. Use of HCB has been declining since the 1970s. However, HCB is still being produced and used by other countries. In addition, the allowable limits of HCB as a byproduct in the production of other chemicals have decreased. Exposure to HCB has caused serious health effects. For example, in the years 1955-1959, HCB-treated grain was processed into bread and consumed by people living in southeastern Turkey. Those with significant exposures developed porphyria and other

manifestations, including weakness, paresthesia, hyperpigmentation, thyromegaly, and arthritis. Children born to mothers exposed during that time developed sores on their skin, and many died within the first 2 years of life (Peters et al., 1982). HCB causes reproductive disorders and developmental disorders in experimental animal studies.

Pentachlorophenol (PCP), 2,4,5-trichlorophenol (245TCP), and 2,4,6-trichlorophenol (246TCP) are urinary metabolites of HCB. Urinary PCP can also result from exposure to other chlorinated hydrocarbons such as pentachlorobenzene, hexachlorocyclohexane, or pentachloronitrobenzene. Similarly, urinary 245TCP and 246TCP can result from exposure to other chlorinated hydrocarbons such as hexachlorocyclohexane. Because urinary PCP, 245TCP, and 246TCP can occur from

**Table 154. Hexachlorobenzene (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1702
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	591
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1111
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	807
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	895
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	583
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	350
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	636

< LOD means less than the limit of detection, which averaged 60.5 ng/g of lipid (SD 19.3, maximum value 118).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

exposures to chemicals other than HCB, measuring HCB in serum is a more specific indicator of exposure to this specific pesticide.

*Interpreting Lipid-Adjusted Serum HCB levels Reported in the Tables*

Generally recognized guidelines for serum levels of HCB are not available. HCB was detected in only 0.6% of people in this 1999-2000 NHANES subsample.

Age-dependent increases of HCB in body fat have been reported (Bertram et al., 1986). Grimalt et al. (1994) showed that residents living near an HCB chemical plant had serum HCB levels that were about fivefold greater than levels of residents from a reference community. In another study, serum HCB levels in workers at an HCB plant were about fivefold greater than levels in the local population (Herrero et al., 1999). In a convenience sample of 287 people living near a dumpsite during the period 1984-1986, the median serum HCB level was 0.189 µg/L (approximately 31 ng/gram of lipid) (Needham et al., 1990). About 25 years after the aforementioned incident in Turkey, the mean HCB level in the breast milk of women with porphyria who lived in the area of exposure was about sevenfold higher than that of women without porphyria who lived outside of the affected area (Peters et al., 1982). HCB has a residence time of about 15 years in body fat.

## Hexachlorocyclohexane

CAS No. 608-73-1

### General Information

Hexachlorocyclohexane (HCH) is an organochlorine pesticide with several isomeric forms: alpha, beta, gamma, and delta. The gamma isomer, commonly known as lindane, is the only isomer with insecticidal activity. The other isomers are used either as fungicides or to synthesize other chemicals and may be formed during the synthesis of lindane. Technical-grade HCH contains all four isomers but mostly the alpha isomer. Although lindane and technical-grade HCH were banned from production in the United States during the late 1970s and early 1980s, these chemicals are still produced

by other countries. In the United States, lindane has restricted use in agriculture and in treating human scabies and lice.

HCH isomers are mainly metabolized to chlorophenols, such as 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, and 2,3,5-trichlorophenol. Beta-HCH has a blood elimination half-life of 7 years, whereas gamma-HCH has a blood elimination half-life of only 20 hours.

### Interpreting Lipid-Adjusted Serum Beta-HCH Levels Reported in the Table

The Deutsche Forschungsgemeinschaft (2000) established a biological tolerance level of 25 µg/L (approximately 4,200 ng/gram of serum lipid) in serum or plasma for

**Table 155. Beta-hexachlorocyclohexane (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	9.68 (<LOD-10.4)	< LOD	< LOD	< LOD	19.0 (17.0-20.7)	42.0 (35.9-47.1)	68.9 (52.7-80.5)	1893
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	11.4 (<LOD-16.2)	653
20 years and older	10.9 (10.1-11.7)	< LOD	< LOD	< LOD	21.0 (19.1-23.8)	46.0 (39.6-50.7)	73.4 (59.3-90.2)	1240
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	14.5 (11.8-17.1)	29.8 (25.1-36.1)	44.6 (37.5-56.2)	901
Females	11.1 (10.2-12.0)	< LOD	< LOD	< LOD	22.0 (19.4-27.5)	51.3 (44.0-64.4)	81.1 (68.9-102)	992
<b>Race/ethnicity</b>								
Mexican Americans	16.7 (13.6-20.4)	< LOD	< LOD	15.5 (11.6-20.4)	37.5 (26.9-51.5)	97.9 (60.9-139)	139 (97.9-200)	632
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	14.7 (12.4-21.1)	36.6 (30.0-41.7)	48.9 (40.9-81.1)	403
Non-Hispanic whites	*	< LOD	< LOD	< LOD	17.5 (15.3-19.4)	34.4 (27.0-44.0)	51.3 (44.6-64.4)	702

< LOD means less than the limit of detection, which averaged 4.8 ng/g of lipid (SD 1.7, maximum value 9.36).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

workers at the end of their shifts. The values reported in this NHANES 1999-2000 subsample are well below this level of concern for workers.

Beta-HCH levels in the U.S. population have been declining since 1970 (Radomski et al., 1971; Stehr-Green et al., 1989; Kutz et al., 1991; Sturgeon et al., 1998). Kutz et al. (1991) estimated that nearly 100% of the U.S. population had detectable beta-HCH in adipose tissue in 1970 and 80% in 1980, with the mean adipose beta-HCH level decreasing from 0.37 µg/gram of lipid (370 ng/gram) in 1971 to 0.10 µg/gram of lipid (100 ng/gram) in 1983. Beta-HCH is usually the isomer with the highest concentration in the general population. In a control population from Canada (n = 70), the mean lipid-adjusted level of beta-HCH collected in 1994 (Lebel et al., 1998) was similar to the geometric mean level in the NHANES 1999-2000 subsample. In 1976, the median serum lipid-adjusted level of beta-HCH was 119 ng/gram

for a control population of 7,712 Danish females (Hoyer et al., 1998). The difference between these 1976 levels and current U.S. levels may represent a global change in levels over time.

An increase of beta-HCH levels with age has previously been observed by the German Commission on Biological Monitoring (Ewers et al., 1999). In addition, a positive age relationship was observed previously in both a non-random subsample from the NHANES II (1976-1980) and for beta-HCH levels in adipose tissue (Stehr-Green et al., 1989; Kutz et al., 1991). Also, higher levels in females had been observed for beta-HCH levels in serum (Stehr-Green et al., 1989) but not in adipose tissue (Burns, 1974). In this *Report*, comparisons of adjusted geometric means were not possible among the demographic groups. Differences similar to those in the aforementioned studies can be observed at the upper percentiles. It is unknown whether differences between

**Table 156. Gamma-hexachlorocyclohexane (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey,

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1799
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	660
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1139
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	863
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	936
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	631
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	380
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	646

< LOD means less than the limit of detection, which averaged 7.5 ng/g of lipid (SD 2.4, maximum value 14.5).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

ages, genders, or races/ethnicities represent differences in exposure, body-size relationships, or metabolism.

*Lipid-Adjusted Gamma-HCH Levels Reported in the Tables*

Lipid-adjusted serum gamma-HCH (lindane) levels were measured in a subsample of NHANES 1999-2000 participants aged 12 years and older. Subsamples were randomly selected within the specified age range to be a representative sample of the U.S. population. Lindane was detected in only 1.7% of the population surveyed for this *Report*, a finding that is similar to other measurements made from non-random samples of the general U.S. population (Radomski et al., 1971; Dorgan et al., 1999). Levels of lindane in the general population of other countries can be higher than levels in the U.S. population (Radomski et al., 1971), probably because of regional variations in the use of the pesticide. The upper reference limit of gamma-HCH in general populations described by the German Commission on Human Biological Monitoring is 0.3 µg/L of blood (Ewers et al., 1999).

Serum lindane levels in workers involved in the manufacture, processing, application, or formulation of HCH were found to be severalfold higher than levels in people with no known occupational exposure to the pesticide (Nigam et al., 1986; Radomski et al., 1971; Angerer et al., 1983). The recommended biological limit value in blood for lindane has been established by various agencies and organizations. The United Kingdom's benchmark guidance value for lindane is 35 nanomoles per liter (approximately 1,700 ng/gram of lipid) in whole blood or 70 nanomoles per liter in plasma (Wilson et al., 1999). The German Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area sets the biological tolerance value for lindane as 20 µg/L (approximately 3,300 ng/gram of lipid) (Deutsche Forschungsgemeinschaft, 2000). The levels shown in this *Report* are far below these levels of concern for workers.

## Dichlorodiphenyltrichloroethane

CAS No. 50-29-3 for technical grade

### General Information

Dichlorodiphenyltrichloroethane (DDT) is an insecticide that was used initially in the 1940s by the military against mosquitoes that carried vector-borne diseases (e.g., malaria). The U.S. EPA banned use of DDT in the United States in 1973, and it is no longer being produced in this country. However, DDT still is being used and produced in limited quantities in other countries. Commercially available DDT (technical grade) contains two chemical forms of DDT: *p,p'*-DDT and *o,p'*-DDT.

Food is the primary pathway of DDT exposure for the

general population. Diets that contain large amounts of fish from the Great Lakes will increase a person's exposure to DDT. The estimated food intake of DDT in the United States has decreased since the 1950s (Walker et al., 1954; Durham et al., 1965; Duggan and Corneliusen, 1972). However, food imported into the United States from other countries that still use DDT may have DDT contamination. Food from tropical regions may contain more DDT because of its greater use in these regions.

A major metabolite of DDT is 1,1'-(2,2-dichloroethenylidene)-bis[4-chlorobenzene] (DDE), which can be produced in people or in the environment. DDE is more persistent than DDT in the environment and in people. The presence of DDT in the body reflects either a

**Table 157. *p,p'*-DDT (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	27.0 (<LOD-34.0)	1679
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	677
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	29.4 (22.2-37.3)	1002
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	24.3 (<LOD-34.1)	799
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	29.1 (22.5-34.0)	880
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	59.7 (28.9-150)	150 (63.4-493)	635
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	25.7 (<LOD-63.9)	356
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	564

< LOD means less than the limit of detection, which averaged 10.6 ng/g of lipid (SD 3.4, maximum value 20.7).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

relatively recent exposure or cumulative past exposure. A high DDT to DDE ratio may indicate recent exposure, and a low DDT to DDE ratio may indicate an exposure in the more distant past (Radomski et al., 1971).

The health effects associated with DDT after large accidental exposures or workplace exposures have been described (Hayes, 1976). Elevations of liver enzymes in serum have been observed in exposed workers. The toxic effects of DDT demonstrated in experimental animals include infertility (Jonsson et al., 1975), a decrease in the number of implanted ova (Lundberg, 1974), intrauterine growth retardation (Fabro et al., 1984), cancer (Cabral et al., 1982), neurologic developmental disorders (Eriksson et al., 1990) and fetal death (Clement and Okey, 1974). The association of DDT exposure and breast cancer has

been studied but not clearly established (Lebel et al., 1998; Hoyer et al., 1998; Helzlsouer et al., 1999; Hunter et al., 1997). IARC classifies DDT (p,p'-DDT) as a possible human carcinogen; NTP considers that DDT is reasonably anticipated to be a human carcinogen; and the U.S. EPA has classified DDT as a probable human carcinogen.

**Table 158. *p,p'*-DDE (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	260 (234-289)	74.2 (66.1-84.2)	114 (99.8-129)	226 (191-267)	538 (485-609)	1120 (991-1290)	1780 (1520-2230)	1964
<b>Age group</b>								
12-19 years	118 (101-137)	45.9 (34.9-56.6)	69.8 (59.2-80.4)	108 (90.6-132)	185 (141-233)	343 (255-479)	528 (364-644)	686
20 years and older	297 (267-330)	86.0 (75.2-96.7)	130 (115-150)	269 (229-303)	626 (538-697)	1250 (1100-1420)	1990 (1570-2510)	1278
<b>Gender</b>								
Males	249 (221-281)	77.6 (68.6-88.2)	119 (101-133)	222 (182-266)	489 (383-570)	985 (756-1130)	1350 (1190-1610)	937
Females	270 (241-302)	68.9 (55.1-82.5)	112 (96.0-129)	228 (191-286)	604 (516-697)	1320 (1100-1600)	2150 (1650-2750)	1027
<b>Race/ethnicity</b>								
Mexican Americans	674 (572-795)	154 (133-214)	300 (252-370)	623 (505-750)	1350 (1090-1660)	3090 (2100-4610)	4940 (3280-7810)	657
Non-Hispanic blacks	295 (253-344)	62.2 (56.9-80.5)	113 (98.3-128)	203 (164-253)	452 (392-571)	1340 (974-1910)	2160 (1470-4010)	416
Non-Hispanic whites	217 (193-244)	73.0 (63.2-82.2)	107 (94.5-127)	197 (175-238)	459 (372-513)	852 (693-1010)	1220 (1040-1410)	732

## Interpreting Lipid-Adjusted Serum DDT and DDE Levels Reported in the Tables

The 95<sup>th</sup> percentile levels for *p,p'*-DDT and *p,p'*-DDE in this *Report* are about 15-fold and 5-fold lower than levels found in 1976-1980 for a non-random subsample from NHANES II participants (Stehr-Green et al., 1989). These decreases in U.S. levels are consistent with the decreased use and manufacture of these chemicals. In 1976, the median lipid-adjusted serum levels of *p,p'*-DDT and *p,p'*-DDE were 141 ng/gram and 1,183 ng/gram, respectively, in a population of 717 Danish females participating in a breast cancer study (Hoyer et al., 1998). For a control population from California during 1989-1990, *p,p'*-DDE was detected in 100% of the samples, and the median lipid-adjusted serum *p,p'*-

DDE level was 1,358 ng/gram (Sturgeon et al., 1998), a level about fivefold greater than levels found in the 1999-2000 NHANES subsample. Local spraying with DDT can add greatly to body burdens. For example, a single application of DDT for malaria control increased serum DDT levels sevenfold in people tested 1 year after the application (Dua et al., 1996). For this 1999-2000 NHANES subsample, *o,p'*-DDT was detected in less than 1% of the population.

Geometric mean levels of the demographic groups were compared after adjustment for the covariates of race/ethnicity, age, and gender. The group aged 12-19 years had more than a twofold lower level of *p,p'*-DDE than the group aged 20 years and older. Similarly, in 1971, lower *p,p'*-DDE levels were found in children

**Table 159. *o,p'*-DDT (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1669
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	667
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1002
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	796
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	873
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	632
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	354
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	560

< LOD means less than the limit of detection, which averaged 10.6 ng/g of lipid (SD 3.3, maximum value 20.7).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

than were found in adults in Argentina (Radomski et al., 1971). In NHANES II participants, levels of *p,p'*-DDE were also shown to increase with age (Stehr-Green et al., 1989). There was no difference in *p,p'*-DDE levels between males and females documented in this *Report*. However, others have reported differences in levels of DDT or its metabolites between females and males (Waliszewski et al., 1996; Stehr-Green et al., 1989; Finklea et al., 1972; Sala et al., 1999).

In the NHANES 1999-2000 subsample, the adjusted geometric mean level of *p,p'*-DDE in Mexican Americans was 653 ng/gram, or about three times higher than levels in non-Hispanic whites and two times higher than levels in non-Hispanic blacks. This higher level of *p,p'*-DDE in the Mexican-American population is similar to levels found in a 1997 study in which the majority of the control population was born in Mexico (Balluz et al., 2001). In 1998, Mexican-American migrant workers had a mean serum *p,p'*-DDE level that was threefold greater than the geometric mean level found in Mexican Americans in this *Report* (Hernandez-Valero et al., 2001). Previous measurements of total DDT congeners in adipose tissue have demonstrated that African Americans had levels that were about twofold higher than levels in non-Hispanic whites (Kutz et al., 1977). It is unknown whether differences between ages or races/ethnicities represent differences in exposure, body-size relationships, or metabolism.

## Chlordane

CAS No.12789-03-6 for technical grade

and

## Heptachlor

CAS No. 76-44-8

### *General information*

Chlordane is an organochlorine pesticide that was once used on agricultural crops and lawns and in buildings to kill termites. In 1988, the U.S. EPA cancelled registration for the production and use of chlordane in the United States.

The technical grade of chlordane consists of several related chemicals, including *cis*- and *trans*-chlordane, *trans*-nonachlor, and heptachlor. Chlordane is primarily metabolized to oxychlordane. Heptachlor (a separate pesticide) is metabolized to heptachlor epoxide. Chlordane is an unlikely source of exposure if heptachlor epoxide is found in the absence of either oxychlordane or *trans*-nonachlor. Because pesticide applications were generally made with technical-grade chlordane, it is the main form of exposure for people. During the period 1981-1982 in Hawaii, heptachlor was applied to pineapples that were subsequently fed to milk-producing cows. As a result, heptachlor appeared in commercial milk products, human breast milk, and serum (Baker et al., 1991).

### *Interpreting Levels of Lipid-Adjusted Serum Levels of Oxychlordane, trans-Nonachlor, and Heptachlor Epoxide Reported in the Tables*

Generally recognized guidelines for serum levels of these metabolites have not been established. The levels for these chemicals in this NHANES 1999-2000 subsample are similar to levels measured in a control population during 1987-1990 (Sturgeon et al., 1998). For a control population from Canada (n = 70) collected in 1994, the mean lipid-adjusted levels of oxychlordane and *trans*-nonachlor were similar to the geometric mean level in the NHANES 1999-2000 subsample (Lebel et al., 1998). The 95<sup>th</sup> percentile level estimated from a non-random subsample of NHANES II (1976-1980) participants (Stehr-Green, 1989) was about two times the 95<sup>th</sup> percentile that is reported here. In another study, Wari-

ishi et al. (1986) reported that Japanese adults had geometric mean levels of *trans*-nonachlor similar to levels documented in this *Report* and oxychlordane levels that were slightly higher.

**Table 160. Oxychlordan (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	21.4 (18.6-23.5)	35.7 (30.5-41.3)	44.8 (41.4-49.6)	1661
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	663
20 years and older	*	< LOD	< LOD	< LOD	24.6 (21.4-27.7)	37.8 (33.5-44.0)	49.6 (44.0-51.2)	998
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	17.8 (15.3-21.1)	30.9 (25.1-37.5)	41.5 (34.2-48.6)	793
Females	*	< LOD	< LOD	< LOD	23.7 (20.6-28.0)	37.4 (31.9-44.0)	49.6 (43.5-53.3)	868
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	16.7 (<LOD-19.3)	29.0 (21.2-39.8)	41.1 (29.8-56.1)	628
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	29.3 (21.8-41.1)	44.7 (36.9-55.7)	350
Non-Hispanic whites	*	< LOD	< LOD	< LOD	22.6 (20.0-25.5)	36.7 (30.1-42.3)	44.8 (38.6-49.8)	559

< LOD means less than the limit of detection, which averaged 7.4 ng/g of lipid (SD 2.4, maximum value 14.5).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

**Table 161. *trans*-Nonachlor (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	18.3 (16.9-19.7)	< LOD	< LOD	18.0 (16.4-20.4)	32.7 (29.5-36.0)	54.6 (47.4-64.5)	77.1 (65.9-84.6)	1933
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	19.0 (<LOD-25.2)	25.2 (18.8-30.1)	664
20 years and older	20.8 (19.2-22.6)	< LOD	< LOD	21.5 (19.3-23.5)	36.0 (32.3-40.0)	59.9 (50.7-67.9)	80.7 (70.7-89.6)	1269
<b>Gender</b>								
Males	17.7 (16.4-19.2)	< LOD	< LOD	17.9 (15.5-20.3)	30.5 (27.5-35.8)	50.5 (45.5-59.2)	66.5 (57.1-82.7)	922
Females	18.8 (17.0-20.8)	< LOD	< LOD	18.4 (16.2-21.9)	33.7 (29.7-38.4)	59.3 (48.2-71.5)	80.8 (71.4-96.3)	1011
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	25.2 (22.9-29.0)	45.8 (36.4-51.8)	56.3 (49.4-74.0)	650
Non-Hispanic blacks	20.3 (17.7-23.2)	< LOD	< LOD	15.3 (<LOD-17.2)	28.0 (24.4-31.9)	55.3 (43.3-77.0)	90.0 (67.2-114)	404
Non-Hispanic whites	19.1 (17.4-20.9)	< LOD	< LOD	19.4 (17.6-22.2)	34.1 (29.7-38.5)	54.6 (45.6-65.9)	78.5 (64.4-88.1)	722

< LOD means less than the limit of detection, which averaged 7.5 ng/g of lipid (SD 2.4, maximum value 14.5).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

**Table 162. Heptachlor Epoxide (lipid adjusted)**

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	< LOD	16.0 (<LOD-20.9)	24.1 (16.9-35.5)	1589
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	638
20 years and older	*	< LOD	< LOD	< LOD	< LOD	18.3 (<LOD-24.7)	27.1 (18.6-38.8)	951
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	19.2 (<LOD-27.1)	760
Females	*	< LOD	< LOD	< LOD	< LOD	18.3 (<LOD-26.4)	28.3 (18.6-47.4)	829
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	15.3 (<LOD-21.4)	22.2 (15.3-46.5)	598
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	16.8 (<LOD-24.1)	336
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	16.8 (<LOD-23.3)	26.4 (15.4-46.1)	539

< LOD means less than the limit of detection, which averaged 7.5 ng/g of lipid (SD 2.4, maximum value 14.6).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

## Mirex

CAS No. 2385-85-5

### General Information

Mirex has not been produced or used in the United States since 1977. This chemical was formerly used in southern regions of the United States to control fire ants.

### Interpreting Lipid-Adjusted Serum Mirex Levels Reported in the Table

Generally recognized guidelines for serum levels of mirex are not available. Mirex serum levels were generally not detectable both in the subsample represented in this *Report* or in a non-random subsample from

NHANES II (1976-1980). In a control population of Canadian women sampled in 1994, the geometric mean lipid-adjusted level of mirex was 3.1 ng/gram of lipid (Lebel et al., 1998).

**Table 163. Mirex (lipid adjusted)**

Geometric mean and selected percentiles of serum concentration (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 12 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1853
<b>Age group</b>								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	659
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1194
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	887
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	966
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	617
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	18.8 (<LOD-58.3)	398
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	688

< LOD means less than the limit of detection, which averaged 7.5 ng/g of lipid (SD 2.4, maximum value 14.6).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

## Pentachlorophenol

CAS No. 87-86-5

### General Information

Pentachlorophenol (PCP) is used primarily as a fungicide to preserve wood in the United States. The use of PCP over the years has decreased as a result of regulations by the U.S. EPA issued in 1984. The general population is exposed through food and water sources, which can be contaminated from either PCP releases or waste-site runoffs or from breakdown products of other organochlorinated chemicals (e.g., HCH, HCB). Homes containing PCP-treated wood are another source of exposure. Workers who use PCP may absorb the chemical through

their skin and lungs. Unintentional overdoses of PCP can lead to inhibition of oxidative phosphorylation and clinical hyperthermia. IARC has determined that pentachlorophenol is possibly carcinogenic to humans, and the U.S. EPA has classified pentachlorophenol as a probable human carcinogen.

### Interpreting Urine Pentachlorophenol Levels Reported in the Tables

Most of the PCP excreted in human urine is either unchanged PCP or PCP conjugated to glucuronic acid and sulfate. Measurements provided in this *Report* include both free and conjugated forms of PCP. The 95<sup>th</sup> percentile level in a non-random subsample from NHANES III participants (Hill et al., 1995) was about

**Table 164. Pentachlorophenol**

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 6 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.30 (.660-2.00)	1994
<b>Age group</b>								
6-11 years	*	< LOD	< LOD	< LOD	< LOD	.760 (<LOD-1.60)	1.65 (<LOD-2.30)	482
12-19 years	*	< LOD	< LOD	< LOD	< LOD	.650 (<LOD-1.90)	2.00 (.660-5.40)	681
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.10 (<LOD-1.60)	831
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	.630 (<LOD-1.20)	1.40 (.660-1.90)	973
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	.860 (<LOD-2.00)	1021
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	.650 (<LOD-1.90)	696
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	.970 (.500-1.64)	1.64 (1.00-2.70)	521
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.30 (.550-2.10)	602

< LOD means less than the limit of detection, which is 0.5 µg/L.

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

eight times higher than the 95<sup>th</sup> percentile for adults reported here. In the German Environmental Survey of 1990-1992, urinary PCP levels for adults were 9.4 µg/L and 12.8 µg/L at the 90<sup>th</sup> and 95<sup>th</sup> percentiles, respectively. For children aged 6 to 14 years, urinary PCP levels at the 90<sup>th</sup> and 95<sup>th</sup> percentiles were 11.7 µg/L and 14.9 µg/L, respectively (Seifert et al., 2000).

(1992) reported levels in municipal incineration workers and control subjects that are similar to levels reported here.

The ACGIH lists a BEI for PCP as 2 mg/gram of creatinine (ACGIH, 2000). Concentrations in this NHANES 1999-2000 subsample are well below this level of concern for workers. Workers involved in timber treatment have urinary PCP levels many times higher (Jones et al., 1986) than levels found in the NHANES 1999-2000 subsample. In another study, Angerer et al.

**Table 165. Pentachlorophenol (creatinine adjusted)**

Geometric mean and selected percentiles of urine concentrations (in µg/gram of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 6 and older</b>	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.12 (.870-1.29)	1994
<b>Age group</b>								
6-11 years	*	< LOD	< LOD	< LOD	< LOD	.930 (.553-1.14)	1.39 (.949-2.53)	482
12-19 years	*	< LOD	< LOD	< LOD	< LOD	.525 (.323-1.00)	1.26 (.529-2.51)	681
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.06 (.857-1.26)	831
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	< LOD	.750 (.462-.947)	1.13 (.874-1.53)	973
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.10 (.818-1.26)	1021
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	.947 (.692-1.57)	696
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	.713 (.391-1.17)	1.34 (.720-1.57)	521
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	1.13 (.845-1.26)	602

< LOD means less than the limit of detection (see previous table).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

## Trichlorophenols

*Metabolites of organochlorine pesticides*

### General Information

The chemicals 2,4,5-trichlorophenol (245TCP, CAS No. 95-95-4) and 2,4,6-trichlorophenol (246TCP, CAS No. 88-06-2) are metabolites of several organochlorine chemicals, including HCH, HCB, and pentachlorophenol. Trichlorophenols are no longer intentionally manufactured, but they may be produced as byproducts of the manufacture of other chlorinated aromatic compounds. Small amounts of trichlorophenols can be produced during combustion of natural materials and

from the chlorination of wastewater that contains phenols.

### Interpreting Urine Trichlorophenol Levels Reported in the Tables

Trichlorophenols are excreted in human urine as unchanged trichlorophenols and as trichlorophenols conjugated to glucuronic acid and sulfate. Measurements provided in this *Report* include both free and conjugated forms of trichlorophenols. Generally recognized guidelines for urine levels of 245TCP and 246TCP have not been established. The levels for these chemicals are higher than levels measured previously in a non-random subsample from NHANES III during 1988-1994 (Hill et

**Table 166. 2,4,5-Trichlorophenol**

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 6 and older</b>	*	< LOD	< LOD	< LOD	1.40 (1.00-2.40)	5.40 (2.50-15.0)	16.0 (4.30-39.0)	1998
<b>Age group</b>								
6-11 years	*	< LOD	< LOD	< LOD	1.30 (1.20-2.00)	4.60 (2.30-11.0)	11.0 (5.30-23.0)	483
12-19 years	*	< LOD	< LOD	< LOD	1.60 (1.00-3.10)	5.40 (2.80-22.0)	24.0 (4.70-40.0)	682
20 years and older	*	< LOD	< LOD	< LOD	1.40 (.970-2.50)	5.30 (2.20-18.0)	18.0 (4.20-46.0)	833
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	1.40 (1.00-2.60)	5.30 (2.50-8.60)	9.30 (5.20-28.0)	974
Females	*	< LOD	< LOD	< LOD	1.50 (1.00-3.00)	6.50 (2.20-27.0)	21.0 (3.20-48.0)	1024
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	1.70 (1.40-3.50)	8.50 (4.70-18.0)	21.0 (12.0-29.0)	697
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	1.20 (.940-1.90)	4.80 (2.20-7.70)	8.60 (4.20-63.0)	524
Non-Hispanic whites	*	< LOD	< LOD	< LOD	1.40 (.960-3.20)	4.50 (2.40-7.50)	9.20 (4.40-25.0)	602

< LOD means less than the limit of detection, which is 0.9 µg/L.

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

al., 1995). The 245TCP levels at the 90<sup>th</sup> and 95<sup>th</sup> percentiles for adults in this *Report* are threefold to sixfold higher than their respective percentile levels in a non-random subsample from NHANES III. Similarly, the 246TCP level at the 95<sup>th</sup> percentile for adults is about sixfold higher than in NHANES III. Levels in this *Report* are also higher than levels reported in municipal incineration workers, control subjects, a general population in Germany (Angerer et al., 1992), and also in a control group of children (Hill et al., 1989).

Geometric mean levels of the demographic groups were compared after adjustment for the covariates of race/ethnicity, age, gender, and urinary creatinine.

Urinary 246TCP levels were higher in the group aged 6-11 years than the groups aged 12-19 years or 20 years and older. Levels in the group aged 12-19 years were higher than levels in the group aged 20 years and older. There were no differences in 246TCP levels for gender or race/ethnicity. It is unknown whether differences between ages or races/ethnicities represent differences in exposure, body-size relationships, or metabolism.

**Table 167. 2,4,5-Trichlorophenol (creatinine adjusted)**

Geometric mean and selected percentiles of urine concentrations (in µg/gram of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 6 and older</b>	*	< LOD	< LOD	< LOD	2.36 (1.60-3.05)	5.50 (3.16-11.9)	11.9 (4.78-20.0)	1998
<b>Age group</b>								
6-11 years	*	< LOD	< LOD	< LOD	2.27 (1.54-3.93)	5.79 (4.03-11.9)	12.8 (5.28-25.4)	483
12-19 years	*	< LOD	< LOD	< LOD	1.44 (1.03-2.19)	3.77 (2.19-10.8)	11.2 (2.71-17.6)	682
20 years and older	*	< LOD	< LOD	< LOD	2.46 (1.64-3.15)	5.71 (3.16-12.7)	11.7 (4.31-20.0)	833
<b>Gender</b>								
Males	*	< LOD	< LOD	< LOD	1.67 (1.08-2.92)	4.24 (3.01-9.55)	9.55 (3.91-16.0)	974
Females	*	< LOD	< LOD	< LOD	2.57 (1.80-4.00)	7.73 (3.01-17.8)	16.2 (4.85-30.2)	1024
<b>Race/ethnicity</b>								
Mexican Americans	*	< LOD	< LOD	< LOD	2.49 (1.79-3.90)	6.89 (4.35-11.7)	11.8 (6.90-16.9)	697
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	1.16 (.831-1.92)	3.39 (2.31-6.08)	6.79 (2.95-18.2)	524
Non-Hispanic whites	*	< LOD	< LOD	< LOD	2.44 (1.60-3.15)	4.72 (3.20-9.55)	9.55 (4.08-19.6)	602

< LOD means less than the limit of detection (see previous table).

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

**Table 168. 2,4,6-Trichlorophenol**

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 6 and older</b>	2.85 (2.58-3.15)	< LOD	1.20 (<LOD-1.20)	2.45 (2.30-2.70)	4.80 (4.00-6.62)	14.8 (8.80-21.0)	25.0 (17.0-37.0)	1989
<b>Age group</b>								
6-11 years	4.47 (3.53-5.66)	< LOD	2.00 (1.20-2.40)	3.72 (2.80-5.20)	11.0 (5.10-18.0)	24.0 (15.0-35.9)	32.0 (25.0-45.0)	481
12-19 years	3.56 (3.06-4.14)	< LOD	1.50 (1.20-2.20)	3.00 (2.70-3.40)	6.00 (4.70-9.10)	20.0 (11.0-32.0)	37.0 (24.0-47.0)	678
20 years and older	2.52 (2.25-2.83)	< LOD	1.20 (<LOD-1.20)	2.40 (2.00-2.50)	4.20 (3.50-5.00)	11.6 (7.59-18.0)	21.0 (13.0-32.0)	830
<b>Gender</b>								
Males	2.92 (2.56-3.33)	< LOD	1.10 (<LOD-1.20)	2.60 (2.30-2.90)	5.10 (3.90-7.79)	15.0 (8.90-21.0)	26.0 (15.0-37.0)	970
Females	2.78 (2.40-3.22)	< LOD	1.20 (<LOD-1.20)	2.40 (2.00-2.60)	4.80 (3.80-6.40)	16.0 (7.50-23.0)	25.0 (16.0-45.0)	1019
<b>Race/ethnicity</b>								
Mexican Americans	2.70 (2.20-3.33)	< LOD	< LOD	2.60 (2.10-3.10)	4.80 (4.10-6.80)	14.0 (8.00-23.0)	22.0 (15.0-32.0)	694
Non-Hispanic blacks	3.14 (2.47-3.99)	< LOD	1.20 (<LOD-1.70)	2.80 (2.20-3.40)	6.40 (3.80-11.0)	18.0 (11.0-31.0)	32.0 (19.0-49.0)	519
Non-Hispanic whites	2.74 (2.48-3.04)	< LOD	1.20 (<LOD-1.30)	2.45 (2.30-2.80)	4.60 (3.90-6.00)	13.0 (7.70-19.0)	20.0 (13.0-36.0)	601

< LOD means less than the limit of detection, which is 1.0 µg/L.

**Table 169. 2,4,6-Trichlorophenol (creatinine adjusted)**

Geometric mean and selected percentiles of urine concentrations (in µg/gram of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
<b>Total, age 6 and older</b>	2.54 (2.28-2.84)	< LOD	1.17 (.950-1.44)	2.38 (2.12-2.73)	4.91 (3.93-6.09)	12.1 (9.41-16.8)	21.2 (14.9-28.5)	1989
<b>Age group</b>								
6-11 years	4.82 (3.91-5.95)	< LOD	2.22 (1.64-2.93)	4.71 (3.40-6.67)	11.5 (7.59-15.3)	21.8 (15.3-31.1)	31.5 (24.7-33.8)	481
12-19 years	2.40 (2.04-2.83)	< LOD	1.22 (.800-1.57)	2.33 (1.98-2.64)	4.27 (3.38-5.54)	11.6 (7.67-13.5)	14.4 (12.1-20.6)	678
20 years and older	2.32 (2.04-2.63)	< LOD	1.04 (.852-1.31)	2.22 (1.89-2.57)	4.25 (3.51-5.44)	9.95 (7.07-14.5)	19.6 (12.4-28.6)	830
<b>Gender</b>								
Males	2.24 (1.92-2.61)	< LOD	.968 (.750-1.30)	2.15 (1.82-2.43)	4.41 (3.64-5.59)	10.8 (7.22-15.3)	17.5 (11.2-28.5)	970
Females	2.88 (2.50-3.32)	< LOD	1.33 (1.05-1.66)	2.63 (2.23-2.96)	5.53 (4.27-6.90)	13.3 (10.1-20.6)	24.7 (16.9-34.4)	1019
<b>Race/ethnicity</b>								
Mexican Americans	2.43 (2.03-2.90)	< LOD	< LOD	2.50 (2.22-2.83)	5.43 (4.04-7.04)	10.8 (8.63-14.7)	18.3 (12.5-21.3)	694
Non-Hispanic blacks	2.13 (1.72-2.65)	< LOD	.899 (.696-1.27)	1.90 (1.58-2.56)	3.97 (3.01-6.47)	11.6 (5.54-19.5)	19.4 (12.7-25.2)	519
Non-Hispanic whites	2.59 (2.27-2.95)	< LOD	1.24 (1.02-1.57)	2.41 (2.11-2.93)	4.87 (3.83-5.88)	11.2 (7.62-16.9)	19.6 (13.2-31.5)	601

< LOD means less than the limit of detection (see previous table).